Uraria picta: An Overview

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ABSTRACT

Uraria picta (Jacq.) DC. (Family: Leguminosae, Papilionoidae) is an important plant species in Ayurvedic medicine and one of the most important constituents of the 10-herb formulation called ‘Dashmula’. The ayurvedic name of the species is Prishni Parni while the trade name is Dabra. The species is endangered, hence requires special attention and an overview was conducted involving the various aspects of U. picta to provide necessary information and to induce interest among researchers for its conservation and utilization in traditional as well as modern systems of medicine.

Keywords: agronomic aspects, anatomical aspects, biochemical analysis, cytological aspects, description, in vitro propagation

INTRODUCTION

A comprehensive overview of Uraria picta (Jacq.) DC. (Family: Leguminosae, Papilionoidae) is presented to provide information, to disseminate knowledge and to evoke interest among researchers. U. picta is reported to be an erect woody herb (Burkill 1985; Okusanya et al. 1991), perennial herb (Nasir and Ali 1970; Turrill and Redhead 1952; Anand et al. 1998; Rahman et al. 2007), perennial shrub (Gill and Husaini 1986) and annual woody erect herb and undershrub (Ambe et al. 2001) with immense traditional uses. The species is also one of the most important constituents among ten herb formulation called ‘Dashmula’ (Khare 2007), a well established Ayurvedic medicine. The Ayurvedic name of the species is Prishni Parni while the trade name is Dabra.

Therapeutic uses

Almost all parts of the plant species are therapeutically important. The root decoction is used to treat cough, cold, chills, fever, antiseptic and general healing (Burkill 1985; Kirtikar et al. 1993; Yusuf et al. 1994; Singh et al. 2002; Khare 2007) while leaves are used as a diuretic, aphrodisiac, general antiseptic and to cure oral sores (Okusanya et al. 1991; Billore et al. 2004). The whole plant is reported to possess antivenom activity against Echis carinata (Allen and Allen 1981; Kirtikar et al. 1993), common name: afai. It is also effective for the treatment of gonorrhea (Jain and Defilipps 1991), gynaecological disorders (Billore et al. 2004) and fracture healing (Sankaran et al. 1964; Prasad et al. 1964, 1965; Gurav et al. 2008). According to African folklore the plant species has also purported medicinal uses, including influencing the sex of the unborn fetus and breaking up of friendship and love affairs (Saunders 1958; Lamb 1979). The plant species (extract of dried arboreal parts) is also reported to possess antimicrobial (Osazuwa and Igboechi 2006; Rahman et al. 2007), acaricidal (Igboechi et al. 1989) and antilucreogenic (Manonmani et al. 1995) properties. Sharma et al. (2009) noted the influence of the root
extract in improving the egg shell quality in older laying hens due to calcium and phosphorus supplements.

Synonyms


Distribution

The species, though widely distributed throughout India (Kirtikar et al. 1993), is increasingly becoming rare and endemic (Anand et al. 1998). U. picta is commonly found in dry grasslands, growing densely and producing poorly viable seeds and it also extends up to 300 m in the Tarai region of the Himalayas (AYUSH 2008). Apart from India, U. picta is also reported from parts of Asia (China, Japan, Bangladesh, Pakistan, Bhutan, Nepal) and Africa (Nigeria, Egypt, Ethiopia, Congo, South Africa) (McNeill et al. 2006; Osahi and Iokawa 2007) and Queensland Australia (Battinoff et al. 2000).

Plant description

As per the cultivation of U. picta in the Experimental field of University of Kalyani in West Bengal plains (22° 99’ N, 88° 45’ E, elevation – 48 feet above mean sea level, sandy loamy soil, organic carbon-0.76%, soil pH 6.85), the species (Fig. 1) is erect (growing period in eastern India – Kalyani University Experimental field – late May to early November), 90.9 cm to 120.0 cm in height, 1 to 3 branched; roots stout (Fig. 5), nodulated, branched (5–8), 35.0 to 55.0 cm in length; leaves alternate, compound, unipinnate, imperipinnate; leaflets 4 pairs with 1 odd as terminal (Fig. 3); opposite, linear-oblong, 13.5 to 15.7 cm long and 2.2 to 3.0 cm wide, obtuse to acute at apex, entire at margin, rounded at base, herbaceous, unicostate reticulate with prominent secondaries, hairy on both surfaces more beneath, green (12163, color confirmed from British Atlas of Colour, 9th Edt., 2007) with copper (26791) shade and with white (00320) blotches along the mid vein on the upper surface, petiolulate; petiolules pulvinous about 3 mm long, hairy, dull green (12163); stipules linear dentate, hairy, acute, dull green (12098); petiolate; petioles hairy, green (12163), pulvinus at base; stipulate; stipules free lateral, ovate, angular, 6-9 mm long × 3.5 mm wide, hairy, green (12163), persistent; flowers small on dense villose spike like racemes (Fig. 2), inflorescence rachis 25.0 to 35.0 cm long (flowering time: June to October), bisexual, actinomorphic, biseriate; flowers small on dense villous spike like racemes (Fig. 3), with inner phloem patches; pith parenchymatous, large (12163, color confirmed from British Atlas of Colour, 9th Edt., 2007) is white (10603 – 43.0 /g541m × 43.0 /g541m) (12098), shade and with white (00320) blotches along the mid vein on the upper surface, petiolulate; petiolules pulvinous about 3 mm long, hairy, dull green (12163); stipules linear dentate, hairy, acute, dull green (12098); petiolate; petioles hairy, green (12163), pulvinus at base; stipulate; stipules free lateral, ovate, angular, 6-9 mm long × 3.5 mm wide, hairy, green (12163), persistent; flowers small on dense villose spike like racemes (Fig. 2), inflorescence rachis 25.0 to 35.0 cm long (flowering time: June to October), bisexual, actinomorphic, bisymmetric; corolla color fuchsia mauve (19163/19163D), stamens 9 + 1, short single styled, superior ovary, 1 loculed containing 2 to many marginal oovules; pistil simple stipitate; pollen grain ovoid, tricollpate, regular and uniform (43.0 μm × 43.0 μm) (Fig. 4); pollen fertility – 97.58% (1562 pollen grains estimated) as assessed from 1% aceto-orcein stain. (Fig. 7).

Figure plate Uraria picta. (1) The whole plant of U. picta; (2) Inflorescence showing flower color; (3) Juvenile leaflets; (4) Fertile pollen grains. (Scale bar = 100 μm); (5) Stout branched root with nodules; (6) Charcoal grey fruits with yellow seeds (A) and brownish black with greenish yellow seeds (B); (7) T.S. of stem showing secondary activity. Transverse fibre patches evident in cortex. (Scale bar = 0.5 mm); (8) T.S. of root with secondary activity. (Scale bar = 0.5 mm); (9) AI cell showing 11/11 chromosome separation (2n = 22). (Scale bar = 10 μm); (10) PMC with 11 II (2n = 22) at MI. (Scale bar = 10 μm).

Seeds of grey pods were 100.0% viable, as assessed by dipping half seeds in 1% aqueous solution of tetrazolium chloride (LOBA Chemie, AR) (Moore 1976) while, seeds of black pods were totally non-viable.

Anatomical studies

Figure 3. (1) Root calcified showing root cap; (2) T.S. of root hair cells; (3) Whole plant showing root system; (4) T.S. of hypocotyl showing primary activity. (Scale bar = 10 μm). (5) T.S. of stem showing secondary activity. Transverse fibre patches evident in cortex. (Scale bar = 0.5 mm); (6) T.S. of root with secondary activity. (Scale bar = 0.5 mm); (7) AI cell showing 11/11 chromosome separation (2n = 22). (Scale bar = 10 μm); (8) PMC with 11 II (2n = 22) at MI. (Scale bar = 10 μm).

Transverse sections (hand sections) of the stem from the basal region (4.0 to 5.0 cm above ground level) and root (6.0 to 7.0 cm below ground level) were made from fully matured plants (at fruit ripening stage; 90-100 days from sowing), and the sections were double stained using 1.0% Safranine (Merck, AR) dissolved in 50.0% alcohol and 1.0% Light green (Merck, AR) dissolved in 90.0% alcohol (Johansen 1940).

Stem (Fig. 7): Epidermis disrupted due to the secondary growth, cells polygonal, hypodermis few cell layered, thick walled cells; cortex (1.21 mm) thicker than hypodermis, fibrous cells present in transverse patches; stellar region extended, phloem as triangular patches outwardly, xylem interrupted with series of ray cells; vessel elements prominent, primary xylem towards center often associated with inner phloem patches, pith parenchymatous, large thick walled polygonal cells, compactly arranged, no intercellular spaces.

Root (Fig. 8): Epiblema disrupted, secondary growth

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present, cork layer (0.46 mm) thick, few cell layered; cortex 25 to 30 cell layered (1.63 mm), cell shape polygonal rounded to oblong, thin walled, compact, scattered dark cells; stele major part, secondary xylem present, ray cells prominent, secondary phloem in patches, peripheral; pith absent, primary xylem present centrally.

Sections were dehydrated using graded alcohol (30.0, 50.0, 70.0, 90.0%) for 5 min each, stained in 1.0% safranin solution for 20 min, destained (removal of superficial stain) repeatedly in 50% alcohol, transferred to 70% (5 min), 90% (5 min) alcohol grades, counter stained using 1.0% light green for 20 min, destained (removal of superficial stain) repeatedly in 90% alcohol and transferred to Xylol for clearing (5-10 min) before mounting in Canada balsam.

Plants were fixed in 10% formalin solution overnight and dehydrated using graded alcohol (30.0, 50.0, 70.0, 90.0%) alcohol grades, then transferred to 100% Xylol for 1 day, then transferred to fresh Xylol and stored at 4°C for 3 days. Sections were dehydrated using graded alcohol (30.0, 50.0, 70.0, 90.0%) alcohol grades, transferred to 100% Xylol for 1 day, then transferred to fresh Xylol and stored at 4°C for 3 days. Sections were dehydrated using graded alcohol (30.0, 50.0, 70.0, 90.0%) alcohol grades, transferred to 100% Xylol for 1 day, then transferred to fresh Xylol and stored at 4°C for 3 days.

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Plantation and agroclimatic factors

The crop can be raised successfully from seeds. It germinates well in humus and sand compared to red earth (Okusanya et al. 1991). Loam to clay loam soil is suitable for its cultivation and the species can tolerate a soil pH of up to 8.5 (AYUSH 2008). However, Okusanya et al. (1992b) reported that wet and moist soil conditions produced significantly better growth than dry or waterlogged conditions. The authors further suggested that the species responded identically to pH 3.5, 5.5 and 7.5. The species also possesses salinity tolerance.

About 4-5 kg seeds are reported to be required for plantation in 1 hectare of land and overnight pre-soaking of seeds in water improves germination (AYUSH 2008). Okusanya et al. (1991) reported that germination frequency increases with decrease in soil moisture and burial of seeds up to 1.5 cm increases germination, thereafter germination leveled off. The authors further suggested that alternating temperatures of 31/21 and 31/15°C favored germination, while 21/15°C inhibited germination.

Land preparation (deep ploughing followed by harrowing twice and leveling), fertilizer application (farmyard manure at 10 tonnes/hectare at the time of field preparation; DAP at 100 kg/ha as basal dose), transplantation (50 to 60 days old seedlings from nursery bed given to field plots), optimum spacing (30 cm × 30 cm in 1 ha land), intercropping (mixed with Desmodium gangeticum and other herbs may be grown in inter-row spaces and in such case spacing and row distance should be increased), weeding (manual weeding recommended at 25, 45 and 90 days after transplantation) and irrigation (after transplantation and repeated at an interval of 12-15 days in summer, depending on monsoon rain) are the cultural practices formulated for U. picta by the National Medicinal Plant Board, AYUSH (2008).

Harvest management

Roots may be harvested at the flowering stage during the months of November–December at Kalyani, West Bengal and stored in humidity free condition. For collection of roots the entire plant is dugout carefully. The approximate yield of dry roots per hectare is 3 to 4 quintals and it accounts to Rs. 80,000 (AYUSH 2008).

Disease and pests

Water stagnation causes stunted growth, curling and browning of leaves; however, the plants recover easily after the stress period is over. No disease or insect pests are reported during the stress period. McCoy et al. (1997) studied the nutritional capabilities of four wild legumes in North-Eastern India including U. picta using seed protein concentrate (SPC) to evaluate contents of amino acids, ash, starch, sugar, fibre, phos- phorus, ether extractive and calories as well as for in vitro enzymatic digestibility by pepsin-trypsin enzyme system. Results indicated promising nutritional potential of these SPCs.

Ambe et al. (2001) estimated the amount of essential amino acids (nutritional value obtained from chemical score, which was about 87.0%) from seeds of U. picta and found it close to cultivated legumes (garden pea, horse bean, kidney bean, among others) and cereals (bread-wheat, rice and barley). The authors also reported that though the lipid content of seed was low (1.6%), but the seed oil contains large proportions of essential and long chain fatty acids. Thus from the potential nutritive value of the seeds of U. picta the species may be included in the diet of rural/tribal populations.

Cytogenetical aspects

From the available literature it seems that only chromosome number n = 11 (Bir and Kumari 1975; Gill and Husaini 1986) and 2n = 16 (Sanjappa and Dasgupta 1977) are reported in the species. Wheeler et al. (1992) and Pridegon et al. (2003) documented 2n = 20 and 22 (18 species analyzed), and 2n = 20 (20 species studied) respectively as the chromosome number for the genus Uraria. Meiotic analysis of U. picta revealed 2n = 22 (Figs. 9, 10) chromosomes always with secondary association of chromosomes and secondary polyploidy has been attributed as the possible cause of it (Bhattacharya and Datta 2010). The authors suggested that the basic chromosome number for the species is x = 6 with probable autoploidy lineage.

In vitro propagation

Micropropagation of U. picta was achieved through axillary bud culture and nodal callus culture (Anand et al. 1998). The authors reported that bud break was best when nodes were cultured in MS (Murashige and Skoog 1962) medium supplemented with NAA 2.0-6.0 μM and N6-benzyladenine (4.4 μM). Competent calluses regenerated into profusely growing shoots on transferring to 0.13 μM N6-benzyladenine and the elongated shoots (5 nodal lengths) were rooted on half-strength MS basal medium and about 400 plants transferred to the field showed 80% survivability. Gurav et al. (2008) performed successful in vitro shoot organogenesis by culturing 1.0 to 1.5 cm length of nodal explant and whole cotyledons (4 weeks old) on basal MS medium with 13.2 μM BAP. The cultured shoots were rooted in half MS medium with 9.8 μM IBA and the regenerated plantlets were hardened and transferred to field.

Biochemical analysis

Rahman et al. (2007) isolated and elucidated the structures of two new isoflavones (5,7-dihydroxy-2′ methoxy-3′,4′,5′-methylenedioxyisoflavone; 4′,5-dihydroxy-2′,3′-dime-thoxy-7-(5-hydroxychromen-7yl)-isoflavone) following UV, IR, MS and 1D and 2D NMR analysis from roots of U. picta. Those compounds were found effective (MIC ranging from 12.5-200.0 μg/ml) against Gram-positive (Staphylococcus aureus NCTC10788 and Bacillus subtilis NCTC8236), Gram-negative (E. coli NCTC90001 and Proteus vulgaris NCTC4175) and fungi (Aspergillus niger NCPF3149 and Candida albicans 1MI949007). Apart from the two new compounds the authors also found six previously known compounds. Yadav et al. (2009) quantified rhoifolin amount by RP-LC method from air-dried, finely powdered aerial parts of the plant species and reported the highest amount (0.571% w/w) from methanolic extract with ultra sonication.

CONCLUSION

A comprehensive overview on Uraria picta is documented with the purpose that it will definitely provide additional emphasis to breeders and geneticists for raising superior
plant types (higher phytochemical yielding varieties) through efficient breeding and induced mutagenesis notwithstanding the significance of its mass propagation and ex situ conservation. Identification and complete evaluation of the phytochemical constituents are most desirable for better utilization of *U. picta* for modern as well as traditional system of medicine. Further, biogenaration of the plant species is also recommendable for globalization and maximizing trade.

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